Unified Global Precipitation Measurements

Status and Prospects

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GPM concept

- GPM Calibrates rainfall from constellation radiometers !

  but ….
  - Climatological tuning is dangerous due to sampling differences
  - Coincident overpass approach is empirical and of little use before or after GPM Core satellite - particularly if reasons for adjustments are not known.

- GPM core satellite can construct a-priori data base for use by radiometers

  - ➢ Not dependent upon Core satellite in orbit
  - ➢ Allows uncertainties to be examined from theoretical viewpoint
  - ➢ Differences among sensors contains information

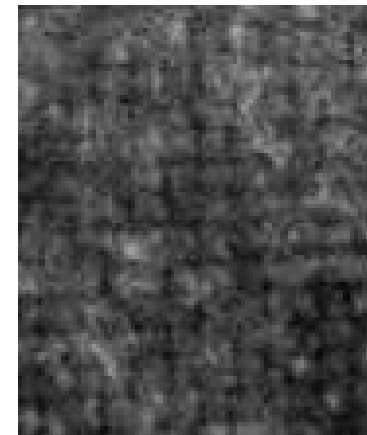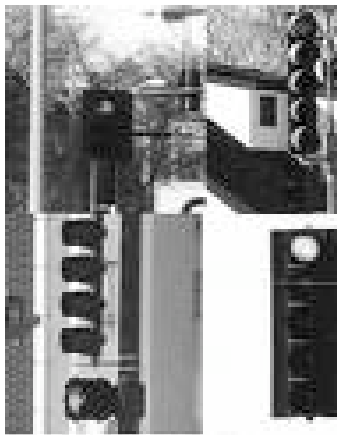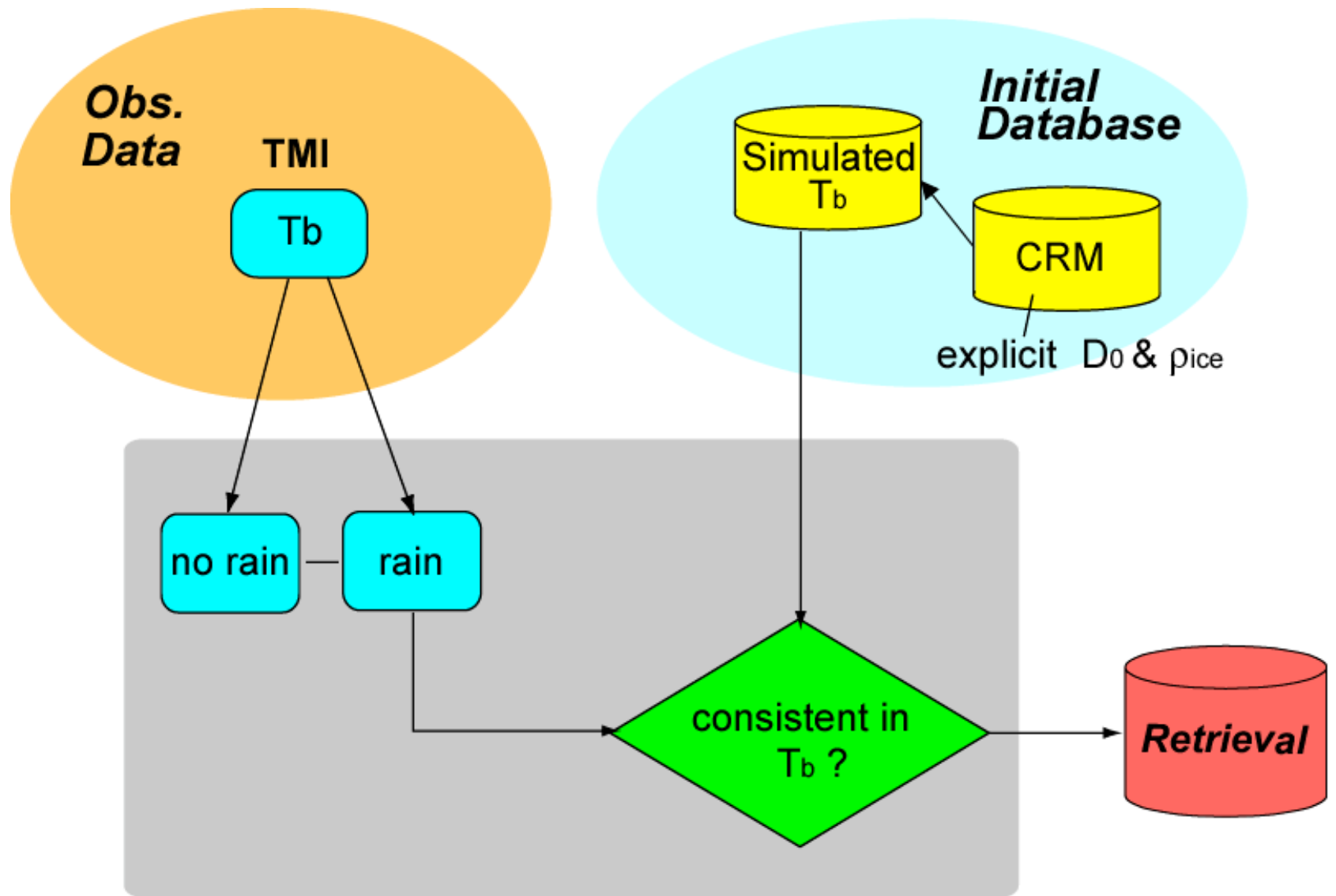# Need for the GPM core satellite
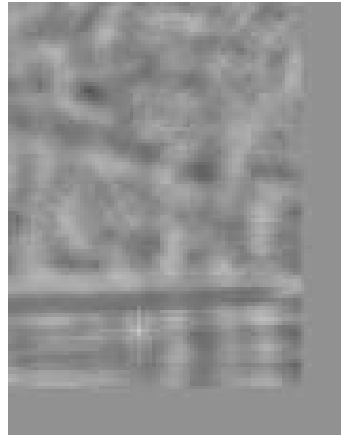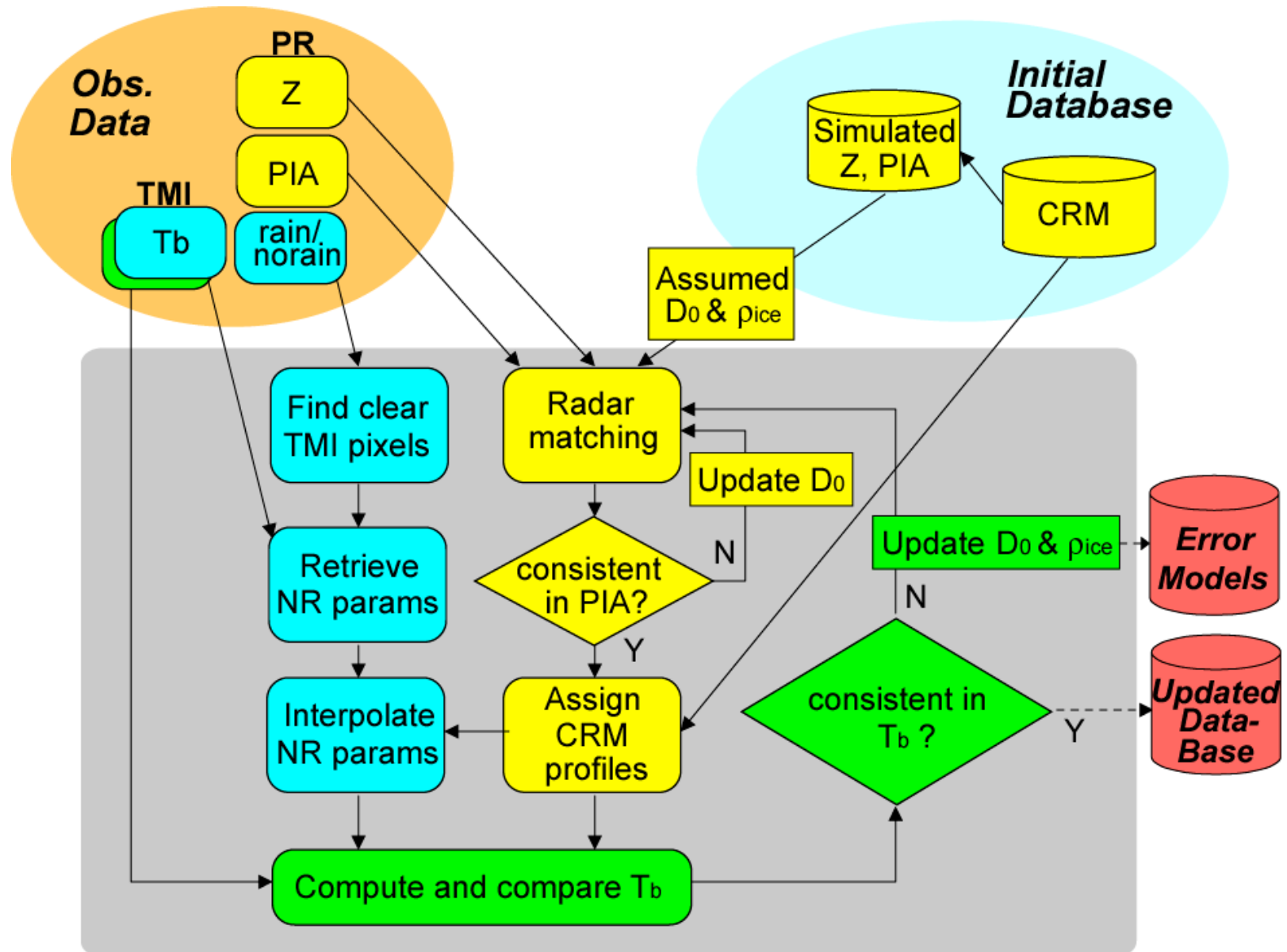

Limited information from a Radiometer

A-priori database from GPM core satellite
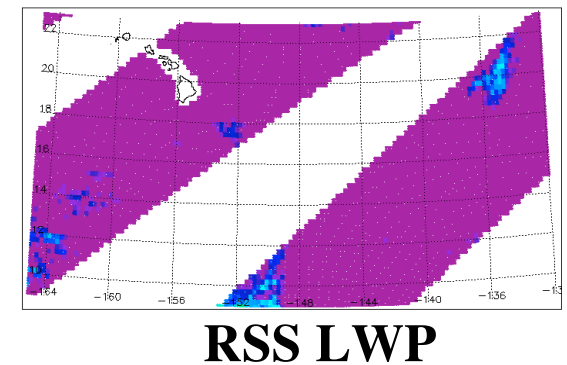
Radiometer retrievals - current methods

The a-priori database

Non-raining background (OE) retrieval

OE TPW

OE WIND

OE LWP

0 — 40 — 80 kg/m²

0 — 17 — 35 m/s

0 — 0.75 — 1.5 kg/m²

RSS TPW

RSS WIND

RSS LWP
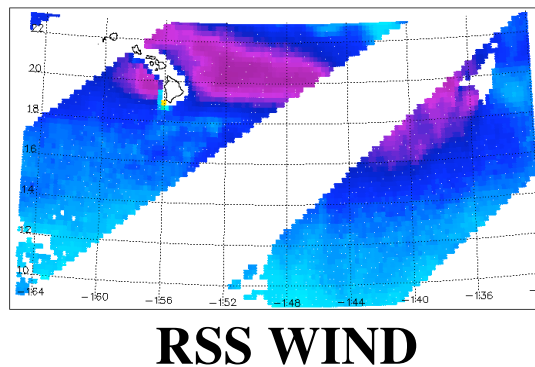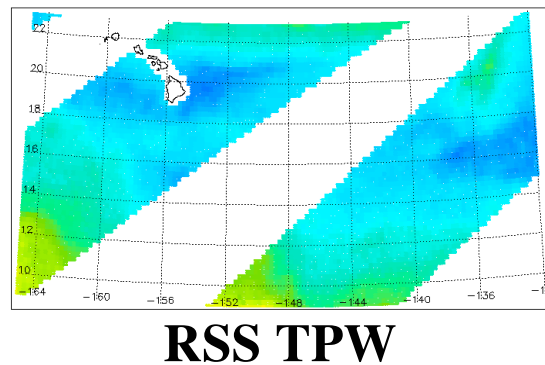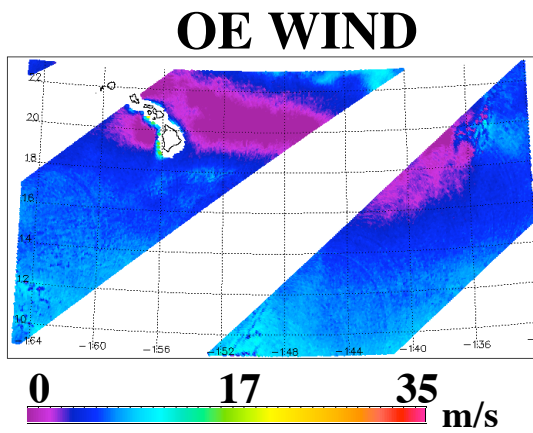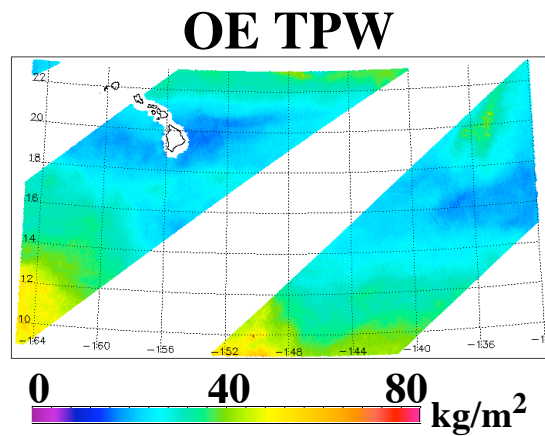
Optimal Estimation - Rain Scene Identification
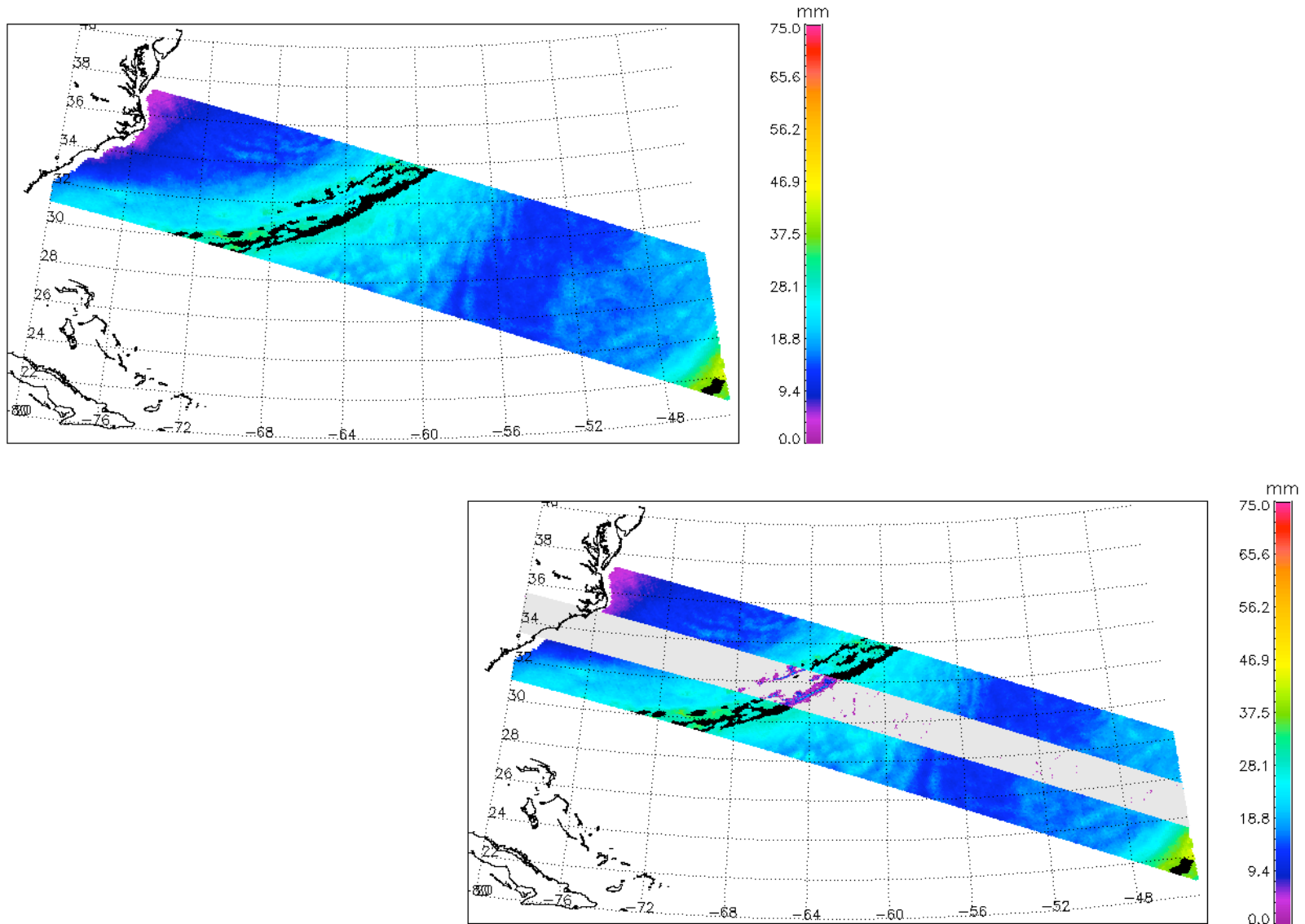
Instantaneous Rainfall

TMI

PR

Land	Ice	Possible Ice	Water	Coast
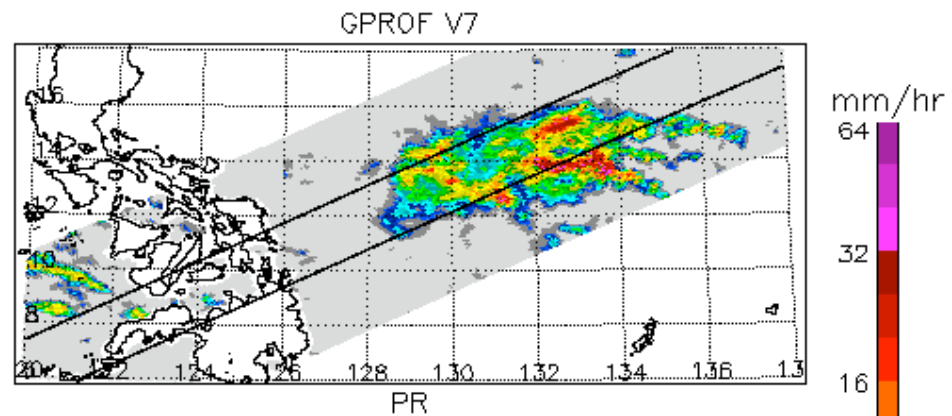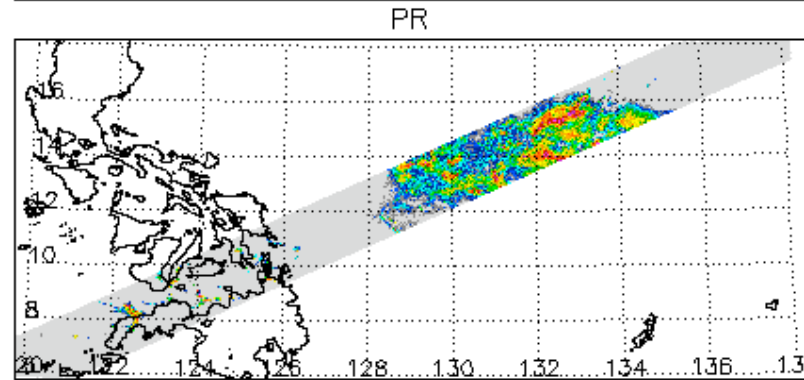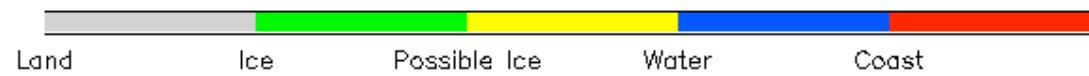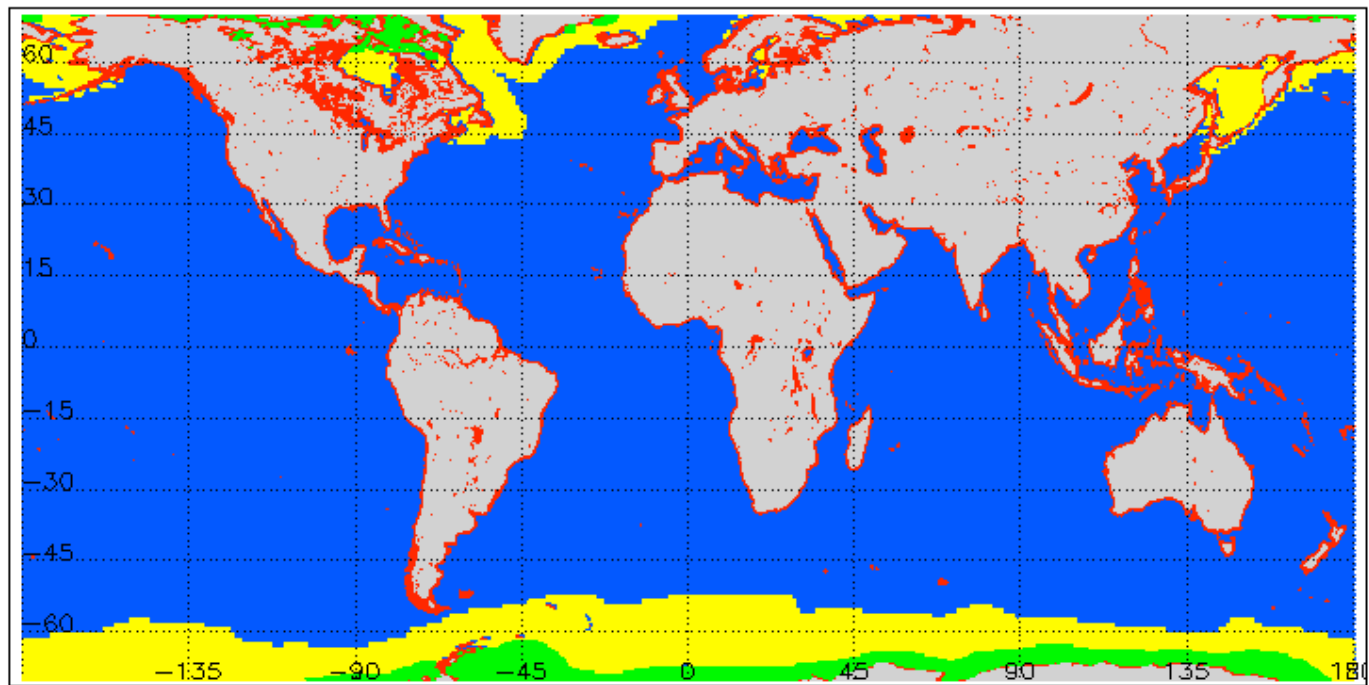
Status over oceans

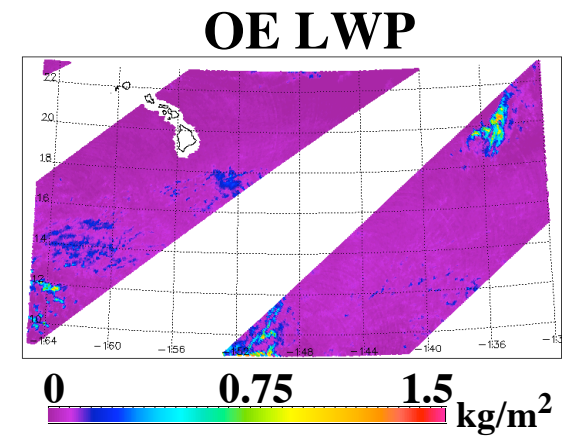- A number of methods now exists that use radar or radar + radiometer for a-priori databases in extended tropics: TRMM-2B31; Grecu and Olson(2004); GPROF2006; GSMaP

    Under development:

    Fast inversion methods (from large a-priori databases)
    Improved LH retrievals
    More complete error models
    Physical discrimination of rain/no rain

- Low Freezing levels currently a problem - lack of good a-priori

    G. Petty working on a scattering/emission algorithm
    GPM will improve greatly

- Sea Ice/Antarctica not receiving much attention as ocean

Status over land

- Emissivity is high and variable. Sfc. emissivity model exists but are in their infancy.

- Historically used scattering channels that are insensitive to surface in deep convection, **but** problems at high latitude where surface is snow or convection is not deep.

- Ice scattering signal is not universally related to rainfall

  Under development:

  ➢ Methods that exploit knowledge of emissivity

  ➢ Methods that more carefully avoid surface by employing HF and Sounding channels. (HF/Sounding channels on Core Satellite are critical for development of physical algorithms)

Atmospheric retrieval over land from passive microwave observations

F. Aires (LMD, FR) and C. Prigent (Obs. Paris, FR)

The problem over land:

- High emissivity: often limited contrast with the atmosphere
- Significant space and time variability
- Difficult to model emissivity on a global basis (lack of reliable models and inputs)

A solution:

- Use of pre-calculated satellite-derived emissivities (and their associated errors) as first guess estimates
- A data base already exists for SSM/I frequencies and observing condition over ten years
- Interpolation method (angle + frequency) developed for other instruments

Monthly-mean emissivity (0.25° resolution) for a year at 19 GHz (horizontal polarization) calculated from SSM/I observations

Microwave emissivity at 19 GHz horizontal polarization (53incidence angle) Month 1993 01
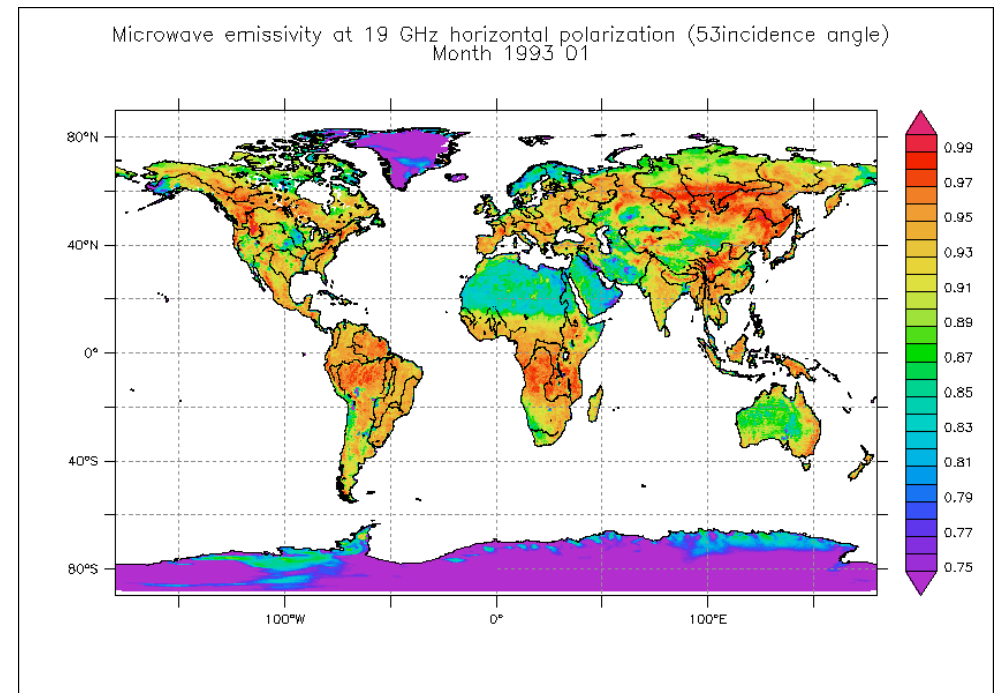
A reliable estimate of the surface emissivity helps evaluate the surface contribution and subtract it from the measured signal in order to isolate the atmospheric contribution. This allows for atmospheric remote sensing and assimilation of satellite observations over land.

AMSU-B Weighting Functions
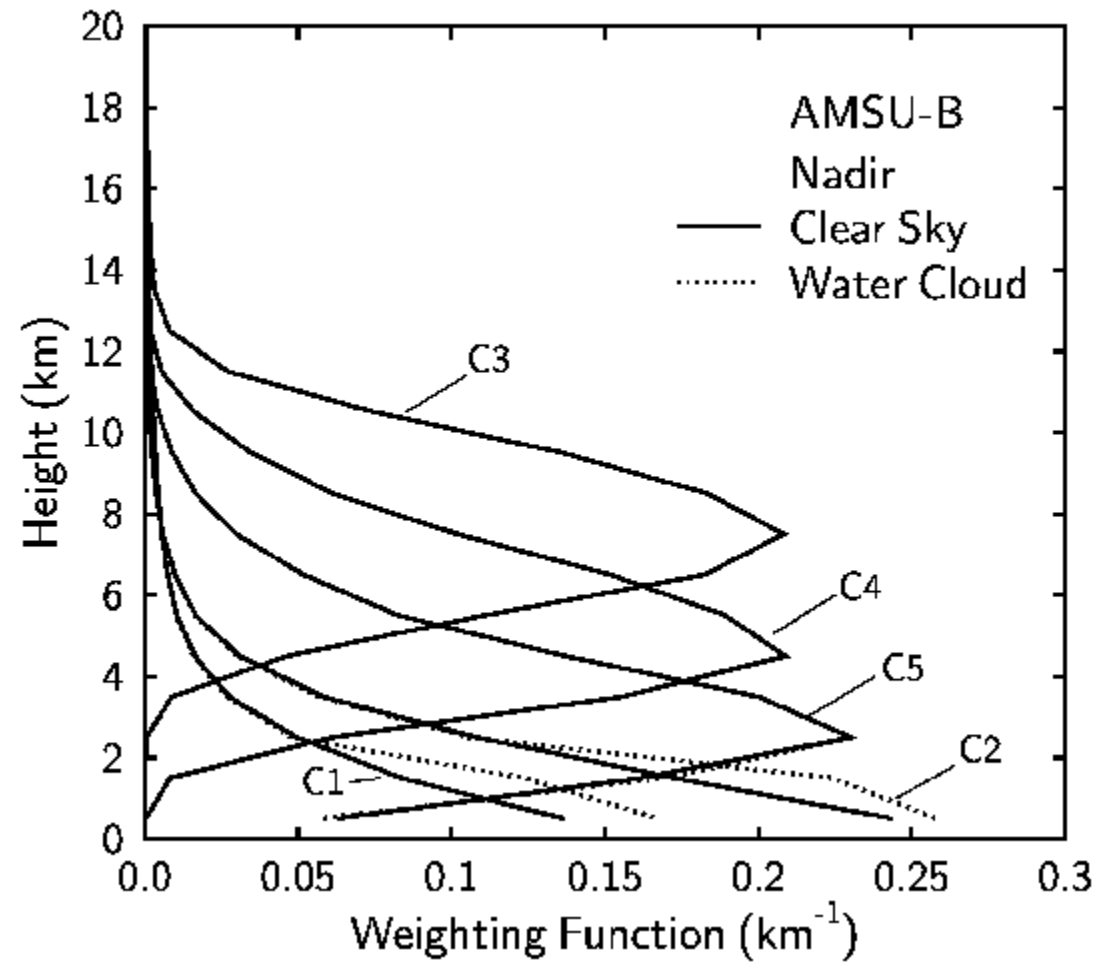
Work in progress for GPM radiometer rain

Implement PR/TMI database for all microwave radiometers.   **R**eplace rain/no-rain discrimination with probabilistic determination. **R**eplace explicit vertical structure with one of ~ 100 profile clusters.

Current Student Projects

Develop optimal estimation framework for diverse geometries (PR/TMI; CloudSat/AMSR-E)

Borrow from land surface community to explore use of emissivity information over "warm" land (then use ocean approach)

Focus on synergy between model and observations -
   Use ECMWF analysis/forecast as a-priori database for retrieval over oceans (data dessimilation)
   Use radar/radiometer observations to "retrieve" model microphysical parameterizations (*i.e.* gain insight to weakly constrained assimilation).